SSVEO IFA List **Date:02/27/2003**

STS - 9, OV - 102, Columbia (6) **Time:04:30:PM**

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-9-V-01	OMS
	GMT: 332:08:42		**SPR** 09F001	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: LH OMS Secondary Pitch Actuator Did Not Respond To Prelaunch OMS Profile. (ORB)

Summary: DISCUSSION: During prelaunch operations, the left-hand OMS (Orbital Maneuvering System) secondary (backup) pitch actuator failed to respond properly in the OMS profile test. Since sufficient redundancy existed within the OMS/RCS system, the backup actuator was disabled for launch. After the OMS-1 maneuver, the secondary actuator was activated and again failed the OMS profile test. The backup actuator was disabled for the remainder of the mission and there was no impact.

Postflight troubleshooting at KSC isolated the problem to the actuator and the actuator was returned to the vendor for failure analysis. During tests at the vendor the actuator was sluggish; and, during disassembly, galling in the actuator bearing cup and its mating part was noted. The outside diameter of the support cup was not dry-film lubricated per drawing. This is the first OMS actuator failure of this type experienced during flight or ground testing. The OMS system is several-fault tolerant, inlcuding primary and secondary actuator channels, and redundant engines. The RCS system serves as an additional backup. CONCLUSION: The failure of the OMS actuator to respond to commands was most likely due to binding caused by interference between the bearing cup and its mating part. The actuators on STS-11 have flown three flights with no problems. Should the problem recur, sufficient redundancy exists in the propulsion systems. CORRECTIVE_ACTION: The results of the continuing failure analysis will be tracked on CAR 09F001. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-9-V-02	GND
	GMT: 332:11:00		**SPR** 09F003	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: LH2 T-Zero Leakage Up To 3.4 Percent Concentration. (ORB)

Summary: DISCUSSION: During prelaunch operations, the GH2 concentrations present at the LH2 T-0 8-in. disconnect assembly approached the LCC (Launch Commit Criteria) limit of 3.6 percent. These concentrations were attributed to the bellows not having sufficient compression on the sealing surface. The replenish valve was left at 7-percent open to increase pressure in the fill system. This increased the compression force of the bellows and maintained the leak rate at a manageable level until lift-off.

The disconnect assembly on MLP (mobile launch platform)-1 (used for STS-9) was measured and is dimensionally shorter than the disconnect assembly on MLP-2 (to be used for STS-11). An apparent distortion of the sealing surfaces also exists, and this can only be verified by removing the disconnect assembly from the T-0 umbilical. Dimensional checks of the disconnect assembly on MLP indicate that the amount of bellows compression is similar to that on MLP-1. However, this assembly has been used for two previous launches without any leakage problems. CONCLUSION: The disconnect assembly leaked hydrogen at an excessive rate during periods of low pressure in the hydrogen fill system. The leakage rate was controlled procedurally to an acceptable level. CORRECTIVE_ACTION: MLP-1: The disconnect assembly will be removed and returned to Downey for verification of sealing surface flatness and dimensional checks of bellows length. 41-B (STS-11) MLP-2/OV-099: Launch preparations will proceed pending results of the evaluation of the disconnect assembly from MLP-1. Depending on these results, the disconnect assembly will be re-shimmed or left as is. This problem will be tracked on CAR 09F003. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification		Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-9-V-03		INS
	GMT:		**SPR**	**UA**		**Manager:**
			IPR	**PR**		
						Engineer:

Title: Operational Instrumentation Failures. (ORB)

Summary: DISCUSSION: A. Hydraulic system 3 body flap return line temperature (V58T0388A) reading low - The parameter read low by 40 deg F compared to system 2 on the first day, then read normal thereafter. Troubleshooting at KSC did not reveal a problem. The problem indicates a possible insulation problem. An additional inspection will be performed at Palmdale.

B. FES (Flash Evaporator System) topping duct aft heater D temperature (V63T1802A) failed - The measurement failed off-scale low, then began reading 200 deg F below the expected level on day 2. KSC troubleshooting did not define a problem. Measurement is not required by LCC (Launch Commit Criteria) so it will be flown as is. C. Mid-fuselage bondline right temperature (V34T1108A) operated erratically. The measurement read high several times during the mission, then returned to normal. KSC troubleshooting could not define a problem. The measurement is now working and will be flown as is. D. Left main landing gear door-close discrete (V51X0116E) indicated release - The release indication lasted for 12 seconds during ascent at the time of maximum dynamic pressure. The proximity sensor was rerigged at KSC. E. Body flap seal cavity drain line temperature (V58T1650A) read low. The temperature droped during ascent, stayed low for 1 hour then returned to normal. KSC

troubleshooting could not define a problem. A possible insulation problem is suspected. An additional inspection will be performed at Palmdale. The measurement is located near the body flap return line temperature (see A. above). F. FCL (Freon coolant loop) 2 payload heat exchanger flowrate (V63R1303A) shifted low - FCL 2 flowrate dropped from 1100 lb/hr to 600 lb/hr when in the payload flow position. The temperature readings showed no change. FCL 2 read about 500 lb/hr lower than FCL 1. Troubleshooting isolated the problem to the transducer. Another flow transducer (V63R1300A) in this loop shifted slightly during STS-9 prelaunch. The measurements will be repaired when the loop is deserviced. G. Hydraulic reservoir pressure 1 (V58P0131A) failed - This measurement failed off-scale low about 5 minutes after touchdown. The loss was the result of the APU wire damage. Repair as part of APU repairs. H. MPS helium supply pressure (V41P1600) dropped to zero - This pressure dropped suddenly about 4.5 minutes after touchdown - This loss was the result of APU wire damage. Repair as part of APU repairs. I. External Tank GH2 ullage pressure signal conditioner 3 malfunction KSC tests show no problem with Orbiter signal conditioner. Data review indicates the valve command circuit performed within specifications. J. APU-3 turbine exhaust temperature (V46T0342A) erratic - During entry the measurement dropped 300 deg F, recovered, then dropped 700 deg F and again recovered after APU shutdown. Repair as part of APU repairs. CONCLUSION: See above. CORRECTIVE_ACTION: See above. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification		Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-9-V-04		STR
	GMT: 332:14:34		**SPR**	**UA**		**Manager:**
			IPR	**PR**		
						Engineer:

Title: Tunnel Adapter Hatch D Leaked. (ORB)

Summary: DISCUSSION: Prior to STS-9, a 3.2 psi cabin leak was successfully performed in the OPF (Orbiter Processing Facility) and the results of a leak check between the hatch seals were satisfactory after the last hatch closing.

While performing the 2-psi cabin leak test during the countdown, the spacelab pressure increased at about 5 lbs/hr with a corresponding Orbiter cabin pressure decrease. A leak between the two modules can only occur through the tunnel adapter hatch D seals or through the air-duct isolation valve and cap. The leak was not a flight constraint, because the leak was between the two modules and internal to the pressurized modules. When the crew opened the tunnel adapter hatch D during the flight, they noted some slight contamination which they wiped away. No damage to the seals was noticed. Postflight, a 1.3-psi difference existed between the Orbiter and spacelab modules and no leakage occurred. During KSC postflight tests of the tunnel adapter hatch D seals and air-duct isolation valve, no out-of-specification leaks were found. CONCLUSION: The cause of the intermodular leak in the tunnel adapter hatch D between the cabin and the spacelab is unknown. The leak was internal to the pressurized modules and was not a flight constraint. CORRECTIVE_ACTION: None required for STS-11. An Orbiter cabin/spacelab leak test will be performed during CDDT (countdown demonstration test) prior to the next spacelab flight. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification		Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-9-V-05		RCS
	GMT: 333:12:42		SPR	UA		Manager:
			IPR	PR		
						Engineer:

Title: Left RCS System A Manifold 3, 4, And 5 Fuel And Oxidizer Isolation Valve Switch Position Indication Failed. (ORB)

Summary: DISCUSSION: After OMS 2 and the on-orbit RCS switch reconfiguration, it was noted that the LRCS system A manifold 3, 4 and 5 fuel and oxidizer isolation valve switch position indication (V42S2345E) did not read "open" when the switch was in the open position. The crew cycled the switch "closed" then "open" and the valve position sensor indicated that the valve was functioning properly. The failure of the valve switch position measurement had no impact on the flight.

Troubleshooting at KSC has isolated the cause to a faulty MDM channel. CONCLUSION: The LRCS system A fuel and oxidizer isolation valve manifold 3,4 and 5 switch position open measurement has failed. The valve is functioning properly as indicated by its position instrumentation. CORRECTIVE_ACTION: The MDM channel will be repaired prior to the next OV-102 flight. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification		Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-9-V-06		HYD
	GMT: 333:16:12		SPR	UA		Manager:
			IPR	PR		
						Engineer:

Title: Water Spray Boiler Lubrication Oil Return Temperature (V46T0350) Overshoot Before Pulsing. (ORB)

Summary: DISCUSSION: During ascent (232:16:12:00 G.m.t.), WSB (water spray boiler) 3 failed to initiate cooling until the APU llube oil temperature reached 288 deg F. The normal control point temperature to initiate lube oil cooling is 253 deg F with the caution and warning limit set at 290 deg F. After reaching 288 deg F, the lube oil termperature dropped to 230 deg F within 38 seconds, after which it increased to 242 deg F at APU 3 shutdown.

The data profile is typical of water spray boiler freeze up. The boiler temperature wall measurement was above 32 deg F; however, localized freezing could have occurred in the area of the lubrication oil spray nozzles. Postflight tests of the WSB were incomplete due to OV-102 powerdown to return the vehicle to Palmdale. During a normal ascent through MECO, the lubrication oil temperature would not reach a level that is detrimental (approximately 350 deg F) to normal system operation. CONCLUSION: The WSB 3 return lubrication-oil-temperature-overshoot-before-pulsing most likely was caused by localized freezing. This condition would prevent the WSB water nozzles from providing cooling until the nozzle temperature had increased. CORRECTIVE_ACTION: None on STS-11. Additional instrumentation prior to the next

flight on OV-102 (STS-17) is being evaluated so that the necessary data can be obtained to verify that localized freezing occurs. The WSB tests will be completed on OV-102 at KSC after return from Palmdale. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-9-V-07	MPS
	GMT: 333:16:10		**SPR** 09F002	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: SSME No. 1 Flow Control Valve (FCV) Failed To Open. (ORB)

Summary: DISCUSSION: Engine 1 GH2 pressurization outlet pressure (V41P1160A) comparisons with GH2 pressurization solenoid 1 close power-on (V41X166E) indicate that the engine 1 FCV failed to open when commanded 13 times. However, the valve did open 3 times with the first being when commanded at approximately lift-off + 7 seconds. The second occurred at the end of the maximum dynamic pressure throttle down period (30 seconds after the command), and the third occurred at lift-off + 300 seconds when commanded for the last time during the flight. Engine 2 and 3 FCV operations were sufficient to compensate for the engine 1 FCV failure.

The OV-102 (-15) GH2 FCV's operated correctly for 5 previous flights (STS-1 through STS-5). This was the first flight on OV-102 at the 104 percent thrust level. The generic marginal pneumatic balance problem is more likely to occur at the higher engine thrust level. The OV-099 engine 1 GH2 FCV did intermittently fail to open during STS-6. This valve was removed, an uprated spring added, and the uprated valve (-25) reinstalled prior to STS-7. No GH2 FCV failures were experienced on OV-099 during STS-7 and STS-8. This failure could recur on OV-099 flights with the present by-pass valve configuration. The first 2 flights on OV-099 were at 104 percent thrust level (STS-6 and 7). OV-099 was flown at 100 percent on STS-8 and plans are to fly at 100 percent on STS-11 and 104 percent on STS-13. CONCLUSION: The SSME No. 1 GH2 flow control valve most likely failed because of a marginal pneumatic balance condition which has been experienced on previous flights. CORRECTIVE_ACTION: The failed GH2 FCV on engine 1 has been removed and returned to the vendor for failure analysis. The results of this analysis will be tracked on CAR 09F002. All OV-102 GH2 flow control valves will be replaced with the new design valve prior to the next OV-102 flight. OV-099 FCV's are scheduled for replacement following STS-13. CAR ANALYSIS: A complete redesign of the flow control valves has been accomplished. All GH2 flow control valves have been replaced with the new -0361 series valves on all vehicles. [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-9-V-08	GND
	GMT: 332:17:20		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Ground Computers Could Not Process Vehicle System Management Data In Format 103. (FSW)

Summary: DISCUSSION: At about 332:17:20 G.m.t., the ground computers could not decommutate (decom) the vehicle System Management (SM) data from either PCMMU-1 or PCMMU-2.

In the PCMMU's there are five toggle buffers which are assigned one each to the five on-board general purpose computers (GPC). Each toggle buffer is split so that the GPC loads SM data in one half while the PCMMU formatters read the other half. The low data rate (LDR) formatter is slaved in time to the high data rate (HDR) formatter. A buffer load/read toggle occurs when the HDR formatter reads a GPC end of message (EOM) on the read side of the buffer and the GPC has sent an EOM to the write side of the buffer. The LDR formatter reads at one half the read rate of the HDR formatter and would supply fill data after word 20 (GPC minor frame has 40 words), if it reads an EOM and if a toggle had not occurred. The EOM, however, was stored with word 40 (read only by the HDR formatter). As a result, the LDR formatter did not supply fill data and continued to read toggle buffer data after word 20 until a toggle occurred. The ground decom was programmed to lock on the LDR SM format 103 or 104 for consecutive SM GPC minor frames of 20 words or for minor frames of 20 words followed by fill data and thus could not decom the SM data in format 103 or 104. A temporary software patch was developed for the ground software which specified SM GPC minor frames of 24 words and this allowed decommutation of the data from PCMMU-2. The patch was not effective for PCMMU-1 playback data, because (due to normal GPC cycle variations) the PCMMU-1 SM GPC minor frame word length varied from 20 to 27 words. PCMMU-2 was used for the remainder of the flight and the SM downlist data were obtained. This problem can only occur when the SM downlist data rate is less than the telemetry toggle buffer downlink data rate. This condition will not be present for STS-11 through STS-13. STS-14 configuration is being reviewed for possible problems. A new ground decom program will be ready for STS-15. CONCLUSION: The SM downlist data was present in the telemetry downlink. A ground software program change was necessary to decommutate and thus retrieve the SM downlist data. CORRECTIVE_ACTION: None required for STS-11 through STS-13. The STS-14 configuration is being reviewed for possible problems. A new ground decomm software program is being developed and planned for use on STS-15. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-9-V-09	DPS
	GMT: 332:18:00		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: General Purpose Computer State-Vector Time Tags To Spacelab Were Incremented By One Day. (FSW)

Summary: DISCUSSION: At about 332:18:00 G.m.t. it was observed that the Orbiter SM (Systems Management) GPC (General Purpose Computer) software processing was adding one day to both the Greenwich true-of-day (earth fixed) and the mean-of-fifty (M5O) state-vector time tags that were being sent to the Spacelab. This affected several Spacelab experiments.

A software analysis revealed a software-design error in the SM GPC code which caused the observed anomaly. A software patch was developed, verified, uplinked, and successfully used for the remainder of the flight. CONCLUSION: The additional day that was added to the state-vector time tags was caused by a software-design error in the SM GPC code. CORRECTIVE_ACTION: A Discrepancy Report (DR 55799) was initiated to authorize the software patch that was uplinked. The code error discrepancy will be corrected on future software releases and the results of this action will also be tracked via DR 55799. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-9-V-10	MECH
	GMT: 332:20:00		**SPR** 09F005	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Airlock Hatch A Difficult To Open. (ORB)

Summary: DISCUSSION: The crew had difficulty in opening airlock hatch A. The unlatching/opening procedure requires movement of the handle clockwise from the one o'clock latched position through 439 degrees to the three o'clock position, and then pulling the hatch away from the airlock opening. Video tapes show that when the crew released the handle, it sprang back to the one o'clock position. The crew realigned the hatch in the opening and cycled the handle to the latched position. Subsequent unlatching resulted in successful opening. KSC also duplicated the problem after landing.

Postflight inspection showed the top hatch guide, (one of five) had debonded. With this guide missing, and if the hatch is moved up in the +Z direction as it is opened, the top kicker dog can bind on the hatch opening sill. Hatch A on OV-099 was exercised and although the hatch could be snagged, the springback of the handle could not be duplicated. All of the guides were intact. CONCLUSION: Crew difficulty in opening hatch A was caused by the upper guide block debonding, allowing the hatch to move up and binding the top kicker dog on the hatch sill. CORRECTIVE_ACTION: No action required on 41-B (STS-11). Evaluation of a fix is being considered for subseqsuent flights and will be tracked on CAR 09F005. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-9-V-11	DPS
	GMT: 332:22:30		**SPR**	**UA**	**Manager:**
			IPR	**PR**	

Engineer:

Title: Spacelab Total Kilowat Usage Computation Reading Zero. (FSW)

Summary: DISCUSSION: At about 332:22:30 G.m.t., the onboard display, which reads the SM (Systems Management) GPC (General Purpose Computer) computation of total Spacelab power, was reading zero. This calculated value is also downlisted and was reading zero on the ground. However, the two parameters (voltage and current) that are used to calculate the power level were reading normal and ground calculations indicated that 5 to 6 kilowatts of power were being used which was slightly below that predicted.

Subsequent software analysis revealed a one-bit code build error which precluded SM GPC computation of the total Spacelab power. In addition, it was found that the HDRR (High Date Rate Recorder) tape record time remaining and the RAU (Remote Acquisition Unit) status computations were not being performed. A software patch was developed, verified, uplinked, and successfully used for all Spacelab special SM GPC computations. CONCLUSION: A one-bit code error precluded the calculation of the Spacelab special computations by the SM GPC. CORRECTIVE_ACTION: For the near term, a special audit will be performed to insure that the single bit, which controls the software, is being properly set. For the long term, a software change, request will be initiated to require setting the bit as a part of the software reconfiguration process. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-9-V-12	C&T - Ku-band
	GMT: 334:15:49		**SPR** 09F020	**UA**	**Manager:**
			IPR	**PR**	

Engineer:

Title: The KU-Band Antenna Traveling Wave Tube Failed To Turn On When Commanded. (ORB)

Summary: DISCUSSION: The KU-Band antenna TWT (traveling wave tube) failed to come on three times when commanded. In each case, the TWT, in accordance with a procedure, had been inhibited to insure that its operating temperature would remain below the upper acceptance test value of 155 deg F. This anomaly had occurred previously on the qualification test unit, but at lower temperatures (less than 15 deg F).

On STS-9, the anomaly occurred at various TWT temepratures; 22 deg F (334:15:49 G.m.t.), 61 deg F (341:11:25 G.m.t.), and at 103 deg F (339:19:28 G.m.t.). Power was cycled from "on" to "standby" and then to "on", but this did not clear the anomaly. However, when the power was cycled from "on" through "standby" to "off" and then "on", the TWT came on and operated normally. This procedure was used successfully for the remainder of the flight with no further mission impact. The anomalous condition observed in flight was indicative of erroneous initiation of the TWT protective logic in the DEA (deployed electronics assembly). This protective logic was reset when the power was cycled "off", then "on", which allowed the TWT to operate. Another potential cause is TWT arcing. The TWT arcing phenomena is generally

associated with new TWT's when they are initially turned on and is more prevalent under cold temperature conditions. The arcing is generally attributed to burnout of small contaminants which escape the cleaning processes during the build cycle. This phenomena tends to be self healing and occurs less frequently with aging. STS-9 TWT temperature trend data indicates that power to the TWT can be applied continuosly, thus negating the periodic "turn off" during STS-11. In addition, the KU-Band power cycling procedure can be used should the same anomaly occur at TWT initial turn on. The KU-Band antenna deployed assembly has been removed and returned to the vendor for failure analysis. CONCLUSION: Failure of the TWT to turn on when commanded was probably caused by a transient condition occurring in the TWT protective logic located in the DEA. CORRECTIVE_ACTION: The KU-Band deployed assembly with the DEA has been removed and returned to the vendor for failure analysis. The results of this action will be tracked via CAR 09F020. CAR ANALYSIS: Unable to duplicate problem (as described) during analysis at the vendor. Two possible explanations exist, neither of which is flight critical since the problem is immediatly identifiable and is cleared with a power cycle. However, investigation is in work to determine what inhibits TWT turn-on logic (sometimes). [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-9-V-13	FCP
	GMT: 334:12:00		**SPR** AC6878F	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Fuel Cell Produced GH2. (ORB)

Summary: DISCUSSION: Prior to STS-9 during CDDT an abnormal quantity of H2 was entrained in the water produced by the fuel cells. Filters had been added to the fuel cell H2 separator to prevent particle contamination of the H2 separator. One of the added filters was removed from the separator of each fuel cell and the effectiveness of this modification was verified by a test program, acceptance tests, and another fuel cell run in the vehicle.

About 28 hours into the mission it was discovered that approximately 20% of the volume in water tank B was gas. The gas was determined to be H2 and the rate at which it was being lost was small (20cc/min) and of no consumables concern. Analysis of the inflight data did not permit isolation of a fuel cell discharge valve problem or a problem related to a zero-G phenomenon. A water management plan was implemented to isolate tanks C and D from any gas produced to preclude possible FES (Flash Evaporator System) shutdown during entry. Several containers were filled with relatively gas-free water for crew consumption and a procedure to separate gas from the drinking water was uplinked to the crew. Postflight tests were conducted with each fuel cell loaded at approximately 100 amps. No gas was observed in the outlet water for the test duration. CONCLUSION: The excessive H2 in the fuel cell water was most probably caused by a zero-G phenomenon within the separator. Vendor tests are underway to understand the problem and provide information for a long term solution. CORRECTIVE_ACTION: An additional G2 separator will be added to OV-099 for STS-11. Vendor testing is expected to provide information for long term fix. Test results will be tracked on CAR AC6878F. CAR ANALYSIS: Testing to understand the problem is complete. A gas bleed hole has been incorporated in the H2 pump separator pitot pick-up tube of the FCP and an additional H2 separator has been incorporated into all vehicles. These two measures are expected to reduce GH2 in FCP water output. [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-9-V-14	RCS
	GMT: 335:10:36		SPR 09F006	UA	Manager:
			IPR	PR	
					Engineer:

Title: RCS Thruster R3D Oxidizer Valve Leakage And Gas Bubbles In L5L And R5R. (ORB)

Summary: DISCUSSION: RCS (reaction control system) vernier thruster L5L indicated failed off by redundancy management at 334:00:29:42 G.m.t., and was automatically deselected. Data indicated a small gas bubble passed through L5L causing low chamber pressure. Affects from the gas bubble were also seen on L5D in the same manifold. The L5L thruster was hot-fire tested and operated normally throughout the remainder of the mission.

RCS vernier thruster R5R was indicated failed off by redundancy management at 335:07:08:00 G.m.t., and was deselected. The problem was diagnosed as bubbles going through the thruster. The thruster was successfully hot fired and operated normally through the remainder of the mission. RCS primary thruster R3D incurred a leak at 335:10:36:58 G.m.t. after one pulse and the thruster was deselected. The initial leak was 1.5 lb/hr of oxidizer. The crew closed manifold 3. About 3 hours later, the manifold 3 valve was reopened and the manifold was repressurized, but with R3D remaining deselected. The leak stopped 113 mission hours later and did not leak during the remainder of the mission. The oxidizer valve did leak gas pressurant after the manifold was drained postflight. CONCLUSION: The deselection of the L5L and R5R vernier thrusters was caused by gas in the propellant cross feed line. It is suspected the gas was trapped during the special STS-9 roll back procedure. The oxidizer valve on R3D exhibited leakage characteristics probably caused by contamination. CORRECTIVE_ACTION: No further action or ground checkout is planned for L5L and R5R thrusters. The R3D thruster will be removed and replaced. Failure analysis for the R3D thruster will be tracked on CAR 09F006. CAR ANALYSIS: Cause of the failure was corrosion of the Pilot Seat Poppet. Corrosion was the result of the wrong material being used to fabricate the seal poppet. All assembled valves and piston assemblies and all delivered hardware has been inspected and corrected to drawing configuration. Valves containing nonconforming parts have been scrapped. [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-9-V-15	C&T - S-Band
	GMT: 333:02:21		SPR 09F030	UA	Manager:
			IPR	PR	
					Engineer:

Title: S-Band Lower Right Quad Antenna Acquisition Intermittent. (ORB)

Summary: DISCUSSION: Intermittent acquisition occurred when the S-Band lower-right quad antenna was used during communications through the TDRS (Tracking and

Data Relay Satellite). Delays in acquisition up to 10 min in duration occurred when attmepts were made to acquire TDRS. After acquisition, data transfer was proper. One potential cause of the problem might be multipath interference resulting from the Orbiter geometry coupled with the Orbiter/TDRS look angles. Data analysis has not confirmed this cause. The other potential cause is the integrity of the coaxial cables and the other S-Band elements. However, troubleshooting at KSC has been inconclusive. All of the S-Band antennas are to be removed (ref. prob. STS-9-18) for analysis.

Should this problem recur, there is a potential loss of data during the acquisition phase of TDRS. No loss of data is anticipated during STDN ground passes. CONCLUSION: Intermittent acquisition by the S-Band lower right quad antenna may have been caused by multipath interference or an intermittent failure within the S-Band and/or its antenna systems. CORRECTIVE_ACTION: The S-Band quad antennas are to be removed for failure analysis. Analysis is continuing to determine whether the look angles could have caused the acquisition delays. Analysis results will be tracked and reported on CAR 09F030. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-9-V-16	C&T - S-Band
	GMT: 337:21:30		**SPR** 09F028	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: S-Band Power Amplifier Number 2 Failed. (ORB)

Summary: DISCUSSION: At about 337:21:30 G.m.t., the S-Band/TDRS link could not achieve two-way lock. After switching from power amplifier-2 (PA-2) to PA-1, the two-way lock was established. Downlink data indicated that the PA-2 power output had dropped from 130 watts to zero watts. A subsequent attempt to use PA-2 resulted in 45 seconds of operation before the output power again fell to zero watts. Consequently, PA-2 was placed in standby and PA-1 was used for the remainder of the mission. Testing at KSC confirmed that the power amplifier had failed.

The failed power amplifier is to be removed and returned to the vendor for failure analysis. Since the power amplifiers are only required for the S-Band return link and since the Ku-Band can also be used for the return link, there is no concern for STS-11. CONCLUSION: The S-Band PA-2 failed during flight operations. CORRECTIVE_ACTION: PA-2 will be removed and returned to the vendor for failure analysis and repair. This action will be tracked via CAR 09F028. CAR ANALYSIS: Loss of power was due to a short in the TWT that developed between the output helix connector and the impedance reducer. This was caused by an incomplete laser braze and is attributed to a workmanship error. The assembly technician has been counselled and assembly documentation has been revised to include assurances of proper laser braze. [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-9-V-17	RCS
	GMT: 336:05:29		SPR 09F022	UA	Manager:
			IPR	PR	
					Engineer:

Title: Right RCS Oxidizer Primary Regulator B Internal Leak. (ORB)

Summary: DISCUSSION: The right RCS (reaction control system) oxidizer propellant tank ullage pressure showed a slow increase after switching to the leg B regulator at 336:05:29 G.m.t. The leak was between 500 and 1000 scch and caused the RCS oxidizer tank ullage pressure to rise to 266 psia while the aft RCS was in OMS interconnect. The RCS oxidizer tank ullage pressure decreased to 253 psia which is normal when the OMS interconnect was terminated and flow from the RCS propellant tanks was reestablished. This internal regulator leakage presented no impact to the mission.

STS-9 postflight testing revealed no problem with the right oxidizer leg B regulator in establishing the health of the unit with respect to future mission operations. No helium regulator leaks have been experienced on OV-099. The most probable cause of the regulator leakage is small particulate contamination which temporarily affected the poppet seals. Resumption of gaseous helium flow through the regulator probably cleared the contamination. Redundancy in the helium system pressure regulation exists from regulators (primary and secondary) in series in each of two selectable parallel paths (leg A or B). CONCLUSION: The right oxidizer leg B primary regulator exhibited a slow internal leak which most likely was caused by contamination. CORRECTIVE_ACTION: None for STS-11 and subsequent. Analysis and problem closeout will be tracked by CAR 09F022. CAR ANALYSIS: Unable to duplicate problem following the flight. The most probable cause of regulator leakage was particulate contamination which temporarily affected the poppet seals. Resumption of gas flow through the regulator probably cleaned the contamination and regulator pressures returned to normal. No corrective action is planned as a result of this anomaly. [not included in original problem report]
EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-9-V-18	C&T - S-Band
	GMT: 338:21:16		SPR 09F029	UA	Manager:
			IPR	PR	
					Engineer:

Title: S-Band Antenna System Reflected Power Was Occasionally Above Normal. (ORB)

Summary: DISCUSSION: Beginning at about 338:21:16 G.m.t. (Day 6), the S-Band system reflected power rose above normal (6W or below) and reached as high as

26W. This occurred when using both of the upper quad antennas. Several peaks of reflected power were observed briefly (minutes) and occurred randomly throughout the mission. The average reflected power was approximately 3W. Communications link performance was not significantly affected by the power changes during the mission.

The increase in reflected power is indicative of a changing VSWR (voltage standing wave ratio) because of a varying impedance in the transmission path to the antenna. This could be caused by connector pin corrosion or burned contacts in the aft/forward beam coaxial switch. Testing at KSC did repeat the problem during the initial troubleshooting. CONCLUSION: The reflected power increase in the S-Band antenna system was most likely caused by an increased impedance in the transmission path to the antenna and was probably in the coaxial cable connectors or the quad antenna switch. CORRECTIVE_ACTION: The S-Band antennas are to be removed at Palmdale and returned to the vendor for failure analysis. This problem will be tracked on CAR 09F029. CAR ANALYSIS: Investigation revealed that a combination of arcing, gas discharging and multipacting deteriorated the switches and caused the malfunctions. These conditions are brought about by the unsealed condition of the switch. The switch procurement specification has been revised to specify RTV sealed switches. [not included in original problem report]
EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification		Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA**	STS-9-V-19	C&T - Ku-band
	GMT: 339:19:28		**SPR**	**UA**		**Manager:**
			IPR	**PR**		
						Engineer:

Title: Simultaneous Ground Command Interface Logic (GCIL) Modes with Ku-Band In Standby Mode. (ORB)

Summary: DISCUSSION: At about 339:19:28 G.m.t., telemetry measurements indicated that three sets of Simultaneous Commands were being generated by the Ground Command Interface Logic (GCIL) when the Ku-Band was in "standby". For the antenna mode, the "GPC" was also present with the commanded "GPC DESIG" mode. The "PL MAX" was present with the commanded "TV" mode and the "PL DIGITAL" was present with the commanded "OP RCDR" mode.

Due to known sneak circuits, the Ku-Band can accept extraneous commands when in the "standby" mode, but will fault down to the proper commands when it is switched to the "operate" mode. Thus no operational problems will result. CONCLUSION: The simultaneous commands observed when the Ku-Band was in "standby" were caused by known sneak circuits. The extraneous commands are not present when the Ku-Band system is in "operate" and thus cause no problem.
CORRECTIVE_ACTION: NONE EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification		Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA**	STS-9-V-20	STR

GMT:	**SPR**	**UA**	**Manager:**
	IPR	**PR**	
			Engineer:

Title: Noises and Oscillations Reported By The Crew. (ORB)

Summary: DISCUSSION: The crew reported loud noises (loud pop) and vehicle oscillations a number of times during the flight. Some oscillations were described as being at a rate of approximately 2 to 3 Hz. A data review was completed for several of those events. The review included DAP (digital autopilot) parameters, RCS firings and cabin integrity data. No cause for the reported oscillations was found.

An examination of possible thermal effects on Orbiter structure and the Spacelab tunnel attachments was initiated. The tunnel adpater, tunnel and Spacelab are connected to the CM (crew module) aft bulkhead and were flown for the first time. This hardware applies significant loads to the CM aft bulkhead, and these loads do vary with the on-orbit temperature changes of the mid-body. However, the thermally induced loads have been considered in the deisgn and have been minimized by the bellows located at both ends of the tunnel. As a result, the thermally induced loads are very small relative to the pressure loads on the bulkhead and should have no noticeable effect on the manufacturing access panel or airlock. The Spacelab tunnel attachments to the mid-body were also examined. The trunnions used in making these attachments are equipped with slip joints to accommodate load variations. During qualification tests of the tunnel with side loads, the trunnions were observed to slip at different times causing the tunnel to suddenly jump. The sudden release of the thermal loads buildup in these support members can cause slight rocking of the tunnel and induce impulse loads to the crew module or Spacelab. A detailed postflight inspection plan was developed and conducted. A visual inspection of all trunnions and keels showed no scratches or any other damage; all of the journals were tight and there was no evidence of a shift in the trunnions. During tunnel removal, all of tunnel flange fasteners were tight and no anomalies were reported, also the forward extension was checked for loose fasteners and none were found.. The tunnel adapter was also checked for loose fasteners at the mating flange with the Orbiter bulkhead, but again all fasteners were tight and no anomalies were reported. An inspection of the crew module was performed and no problems were found. After the removal of all Spacelab associated hardware was completed, an inspection during removal of the bridge and keel from the Orbiter revealed no loose hardware in any of the bridges or keels, with all locations being tight, and no anomalies reported. The disassembly of Spacelab and associated hardware from OV-102 revealed no loose mechanical connections and no mechanical anomalies were found. CONCLUSION: The noises and oscillations reported by the crew were most likely caused by the sudden release of thermally induced loads in the slip joints of the Spacehad tunnel attachments to the Orbiter mid-body. Spacelab/Orbiter attaching structure is designed to accommodate these occcurences. The sudden release of thermally induced loads is peculiar to payloads which are attached to the Orbiter with similar support structure and is of no concern for STS-11. CORRECTIVE_ACTION: None for STS-11. A review of the Spacelab strain gauge data from the attachment structs will continue in an effort to establish that the induced loads are within acceptable limits.
EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-9-V-21	C&T - Ku-band
	GMT: 341:05:35		SPR 09F021	UA	Manager:
			IPR	PR	
					Engineer:

Title: KS-Band Gyro Package Overtemperature. (ORB)

Summary: DISCUSSION: At about 341:05:35 G.m.t., between TDRS passes, the Ku-Band deployed assembly gyro package temperature (V74T2967) rose sharply to about 250 DEG F before the crew was requested to open the heater circuit breaker. Subsequent checks of the gyro heater showed nominal peformance, but the deployed assembly heater circuit breaker was pulled for the rest of the mission to prevent recurrence of the problem. The temperature was monitored to insure that it stayed within acceptable ranges.

CONCLUSION: The Ku-band gyro heater thermostat apparently stuck closed and subsequently operated normally. CORRECTIVE_ACTION: The Ku-band deployed assembly (which contains the gyro heater circuit and thermostat) will be removed and shipped to the vendor for failure analysis. This action will be tracked via CAR 09F021. CAR ANALYSIS: Cause of overtemp was the heater and probably caused by a short between the leads on the 01 heater transistor. No other action is planned and this problem could not be duplicated. Close this CAR. [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-9-V-22	INS
	GMT: 340:15:39		SPR 09F016	UA	Manager:
			IPR	PR	
					Engineer:

Title: Oxygen Tank 3 Quantity Measurement Indicated A Rapid Drop. (ORB)

Summary: DISCUSSION: At 340:15:39 G.m.t., the quantity measurement (V45Q1305A) in oxygen tank 3 dropped from 58 percent to 38 percent instantaneously. Oxygen continued to be supplied from the tank. Throughout the mission, the quantity indication was erratic, but at times provided correct readings. As a backup, the oxygen tank 3 quantity was determined by PVT calculations and from known fuel cell usage for the remainder of the mission. In addition oxygen tank 3 was depleted before oxygen tank 1 and oxygen tank 2 so that the total quantity of oxygen would be known should further mission extension be required. There was no mission impact. At landing, the oxygen tank 3 quantity was indicating properly and continued to do so post flight. Troubleshooting actvities at KSC could neither duplicate nor isolate the problem (spacecraft wiring was flexed). Since the quantity sensor (capacitance probe) is of rugged construction, the intermittent condition is most likely in the signal conditioner.

The signal conditioner was removed and returned to the vendor for failure analysis. Should the same failure occur for STS-11 the oxygen tank quantities can be determined as previously described.

CONCLUSION: The most probable cause of the oxygen tank 3 quantity-erratic measurement was an intermittent condition in the signal conditioner. CORRECTIVE_ACTION: The oxygen tank 3 quantity signal conditioner was removed, replaced and returned to the vendor for failure analysis. This action will be tracked via CAR 09F016. CAR ANALYSIS: Unable to repeat flight anomaly. CAR concludes that this was an unexplained anomaly. No corrective action was taken and removed part (signal conditioner) has been returned to stock. [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-9-V-23	DPS
	GMT: 342:11:10		**SPR** 09F007 and 09F008	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: General Purpose Computer 1 Failed The Redundant Set. (ORB)

Summary: DISCUSSION: At about 342:11:10 G.m.t. the GPC (General Purpose Computer) -1 failed to synchronize with GPC-2. This occured within milliseconds of two Reaction Control System primary jet firings. All attempts on orbit to reinitialize GPC-1 and to obtain a memory dump were unsuccessful.

Postflight, GPC-1 was removed and returned to the vendor. A memory dump revealed that data bit 13 had been picked at even address locations on the memory page in slot A16. A particle impact noise detection test revealed that a memory sense amplifier contained a 0.011-inch solder silver which could have induced short circuits and thus caused the observed anomaly. CONCLUSION: The GPC-1 failure was caused by a metal-particle-induced short circuit in a memory sense amplifer. CORRECTIVE_ACTION: For STS-11 a complement of purged and proven GPC's will be installed on OV-099. Three GPC's that have been screened for particles in the sense amplifiers will be placed in critical positions (slots 1, 3, and 5) and two proven GPC's with hundreds of hours operating successfully in zero gravity will be placed in slots 2 and 4. In addition a spare GPC will be stored onboard for crew installation if needed. For future flights all remaining flight GPC's will be screened for particles in the memory sense-amplifiers prior to flight. The results of this action will be tracked via CAR's 09F007 and 09F008. Also a spare GPC will be stored onboard for STS-11, STS-13, and STS-14. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-9-V-24	GN&C
	GMT: 342:16:42		**SPR** 09F014	**UA**	**Manager:**

IPR **PR**

Engineer:

Title: IMU 1 BITE Messages. (ORB)

Summary: DISCUSSION: Between 342:16:34 G.m.t. and 342:16:43 G.m.t., several IMU 1 BITE (built in test equipment)/T (temperature) messages occurred. After AOS (acquisition of signal) at about 342:16:48 G.m.t., the BITE had isolated the problem to a failed dc/dc no. 1 card (provides plus/minus 15 volts and 5 volts internally to the IMU) in the IMU 1 power supply. Later at 342:17:03 G.m.t. and again at 342:17:06 G.m.t., additional fault messages indicated that IMU 1 had failed and it was thus by-passed. The crew powered down the unit, waited 15 seconds, placed power back on, and initiated an I/O reset. The unit could not be recovered. IMU 1 was powered down for the remainder of the flight and this action had no further impact on the mission.

After the flight, the failed unit was removed and returned to the vendor where failure analysis disclosed a faulty capacitor in the +5 volt power supply. Vendor testing has shown that the capacitor failure was humidity related (degradation of leak resistance) and was associated with capacitors that have a specific lot date code (77XX). IMU's containing capacitors with this lot date code have been identified. Two of these IMU's are installed in OV-099. For STS-11, these two IMU's (serial no. 004 and serial no. 013) on OV-099 will be replaced with units that do not contain capacitors with the 77XX lot date codes (serial no. 009 and serial no. 011). These capacitors are used in 30 orbiter LRU's, but only 4 of the LRU's use capacitors from the vendor of the suspect lot and the suspect 77XX lot date code has only been used in 3 LRU's on OV-099 - the IMU's, the MIA's (multiplex interface adapters), and the quantity gaging signal conditioner of the power reactment storage assembly. The latter is a non-critical flight item. On OV-099, 7 double MIA's out of the 60 used have capacitors with the suspect lot date code. One double MIA with a suspect capacitor is in the slot 5 GPC and the other is in the carry-on spare. Since these capacitors are used in parallel with a low impedance power supply output, they become self healing (moisture is baked out) if the leakage resistance degrades and will not affect MIA operation. CONCLUSION: Loss of IMU 1 was caused by a failed capacitor in the dc/dc no. 1 card +5 volt power supply. The failure was traced to capacitors with a specific lot date code and the degradation of resistance was humidity related. Two double MIA's on OV-099 have suspect capacitors, but the failure mode is self correcting in this application. CORRECTIVE_ACTION: For STS-11, the two IMU's with suspect capacitors will be removed and replaced with units that do not contain capacitors from the 77XX lot date code. Capacitor retrofit for all IMU's with suspect capacitors is being reviewed. Usage of capacitors from the 77XX lot date code is being evaluated for other orbiter LRU's. No additional corrective action is required on OV-099 for STS-11. The results of this activity will be tracked on CAR 09F014. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-9-V-25	DPS
	GMT: 342:11:16		**SPR** 09F010 and 09F009	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: General Purpose Computer 2 Experienced Memory Alterations on Orbit And Failed The Redundant Set At Nose Wheel Touchdown. (ORB)

Summary: DISCUSSION: At about 342:11:16 G.m.t., about six minutes after GPC (General Purpose Computer) -1 failed, GPC-2 failed. As with the GPC-1 failure (see problem STS-9-23), the GPC-2 failure occurred within milliseconds of two Reaction Control System primary jet firings. GPC-2 was reinitialized and the downlisted memory dump revealed numerous altered memory locations. Following analysis, the condition was thought to be a transient phenomena and GPC-2 was used in the redundant set with GPC's 3 and 4 for entry and landing. At nose wheel touchdown (342:23:47 G.m.t.), GPC-2 failed the redundant set.

Postflight, GPC-2 was removed and returned to the vendor. Analysis of the memory dump revealed 7 locations on A20 memory page with all bits dropped and 5 locations on A17 memory page with modified store protect bits. A particle impact noise detection test and subsequent component disassembly revealed that a 0.0015-inch gold plated carbonized fiber was in a memory sense amplifier whihc could have induced short circuits and thus caused the observed anomaly. CONCLUSION: The GPC-2 failure was caused by a meltalized-particle induced short circuit in a memory sense amplifier. CORRECTIVE_ACTION: For STS-11 a complement of purged and proven GPC's will be installed on OV-099. Three GPC's that have been screened for particles in the sense amplifiers will be placed in critical positions (slots 1, 3, and 5) and two proven GPC's with hundreds of hours operating successfully in zero gravity will be placed in slots 2 and 4. In addition a spare GPC will be stored onboard for crew installation if needed. For future flights all remaining flight GPC's will be screened for particles in the memory sense-amplifiers prior to flight. The results of this action will be tracked via CAR's 09F010 and 09F009. Also a spare GPC will be stored onboard for STS-11, STS-13, and STS-14.
EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-9-V-26	APU
	GMT: 342:23:54		**SPR** 09F012, 09F013	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Auxiliary Power Units 1 And 2 Underspeed Shutdown. (ORB)

Summary: DISCUSSION: Six minutes and fifty seconds after the Orbiter landed, APU (auxiliary power unit) -1 shut down automatically because of a turbine-underspeed condition. Four minutes and twenty-four seconds later, a detonation occurred in APU-1, simultaneous with an automatic shutdown of APU-2, also the result of a turbine-underspeed condition. Fourteen minutes and forty-two seconds after APU-2 shutdown, a detonation occurred on APU-2. APU-3 ran normally until the crew shut down the unit approximately 12 minutes after landing.

Postflight data review indicated that hydrazine leakage first occurred approximately 17 minutes after APU-1 and -2 were started for entry. This condition was indicated by valve-module cooling caused by hydrazine evaporation. The hydrazine accumulated in an ice state between the valve-mounting plates and the gas-generator radiation shield. As entry continued and the lower altitudes were reached, flash evaporation ceased, melting began, and the liquid hydrazine ran down on to the hot turbine housing surfaces. The ambient pressure in the aft fuselage reached a level that would support decomposition at approximately 4 minutes and 30 seconds prior to landing. Hydrazine decomposition and subsequent release occurred as indicated by valve module heating approximately 4 minutes prior to landing for APU-1 and 2 minutes prior to landing for APU-2. A full hydrazine-products combustion developed on the upper portion of each of the APU's. Numerous instrumentation and electrical wires on both APU's were damaged by fire. The APU-1 shutoff valve electrical current was interrupted, closing the modulation valve which caused an APU underspeed condition. The system fuel isolation valve also closed, automatically isolating the APU-1 fuel supply. Residual heat from the fire, combined with normal heat soakback, caused the modulation valve and associated tubing to overheat to approximately 500 deg F. The trapped hydrazine explosively decomposed and the APU-1 modulation valve detonated. The detonation caused the APU-1 high-point bleed quick-disconnect poppet to be expelled through the flight cap and sent shock waves up the fuel line which detonated fuel vapor bubbles in the fuel pump cavity. Additional hydrazine was sprayed into the aft compartment at the time of APU-1 detonation as indicated by the splash pattern on the avionics bays. Apparently, the shockwave from the APU-1 detonation caused the already damaged wires on APU-2 to short, closing the modulation valve causing APU-2 to shut down. This resulted in an automatic isolation valve closure which isolated the APU-2 fuel supply. The residual heat from the fire combined with the normal heat soakback to cause the APU-2 modulation valve to detonate resulting in a high-point bleed quick disconnect blowoff and a subsequent fuel pump detonation. Inspection of the aft compartment at the APU-1 location revealed minor hydrazine splash in the area of the APU mounts and on top of the avionics bays. There was smoke and heat discolorations on the insulation and structure forward of the APU and on the exhaust duct above the APU. Minor shrapnel damage was noted. APU-2 had a splash pattern similar to APU-1, except more extensive. The smoke and heat discolorations were evident to a greater degree than on APU-1 and at locations higher above the APU. Also, minor shrapnel damage was noted. The tear-down and inspection of both APU's revealed that the damage was similar and limited to the fuel systems and wiring. Further inspection of the APU injector tubes revealed that both tubes were cracked circumferentially upstream of the thermal shunt. The APU stems had intergranular cracks from the inside diameter to the outside diameter for 225 deg on APU-1 and 180 deg on APU-2 around the circumference of the stems. All microstructure indicated intergranular carbide precipitation at the inside diameter. The most probable scenario describing the cause of the APU stem failure is as follows: During the manufacturing operations (braze cycle), a slow cooling of Hasteloy B, which is the APU stem injector material, from 2100 deg F to 1100 deg F resulted in carbide precipitation at the material grain boundaries. Additional carbon believed to be available from electro discharge machining of the stem bore diffused into the alloy during the brazing operations. A variance in cooling rate between the inside diameter and outside diameter during the braze cycle caused enhanced carbide precipitation near the inside diameter. The resultant microstructure was sensitized, which means that the corrosion resistance of the grain boundaries was reduced. The sensitized surface contacted an aggressive environment (hydrazine, air, moisture, carbon dioxide, ammonia) with attack accelerated at a region-of-stress concentration due to sustained stress levels (injector stem preload caused by manufacturing assembly misalignment). The crack progressed until stress levels and/or availability of corrodant changes allowed the fracture to finish under mechanical or thermal fatigue conditions. The most suspicious corrodant is Carbazic acid. The above scenario is considered to be time dependent. The failure mechanism is thought to be stress corrosion which requires a susceptible material, an available corrodant, and the presence of a sustained surface tensile stress level. System redundancy exisits in that there are three APU systems to support ascent and entry. The APU flight mission rules are being modified to evaluate data during ascent, orbit, and up to entry interface with management of the APU's dependent upon indication/verification. The APU's installed in OV-099 for the STS-11 flight have the lowest propellant exposure and run time of any in the Orbiter inventory. The first propellant exposure since the vendor acceptance test will be at the

launch site for the hot-fire test in support of STS-11. CONCLUSION: The APU failures most probably resulted from a crack in the injector stem caused by corrosion of the sensitized inside diameter surface. The corrodant is probably Carbazic acid or some similar substance which can be derived from air, moisture, CO2, hydrazine and/or ammonia. The corrosion is time dependent and the crack progressed under sustained stress levels from the inner diameter surface toward the outer diameter surface until mechanical or thermal fatigue conditions could finish the crack rupture. CORRECTIVE_ACTION: 1. Install APU's (from OV-103) with low hydrazine exposure and run time on OV-099 (STS-11). 2. Install APU plugs and institute a gaseous nitrogen purge after APU hotfire to inert the APU gas generator and stem cavities. 3. Perform APU hot-fire prior to the STS-11 mission. Provide special APU hotfire instrumentation for use in verified acceptability of APU's for mission support. 4. Failure analysis for the APU's will be tracked on CAR 09F012 for APU-1 and CAR 09F013 for APU-2. 5. An anomaly investigation team has been established and charged with review and determination of the probable causes of the STS-9 APU anomalies. The team will determine and recommend the modifications and associated certifications that will be required for future program operations. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification		Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-9-V-27		MECH
	GMT:		SPR	UA		Manager:
			IPR	PR		
						Engineer:

Title: Right Outboard Brakes Damaged. (ORB)

Summary: DISCUSSION: The right outboard brakes locked up during tow. After backing the vehicle a short distancce the wheel subsequently rolled free for the remaining tow back. Eight carbon brake lining segments on the number 4 rotor and five segments on the number 3 stator were completely missing. A large amount of carbon powder was found in the brakes. Twenty retainer washers were missing. Six of these washers were found in the brake debris, of which, two had a section missing. No beryllium damage was found.

Retainer washer failure has occured on the right main gear brakes on the last two flights of OV-099, but this is the first occurance of this type of failure on OV-102. Evidence suggests that brake/hydraulic dynamic interaction may cause the retainer washers to crack and fail. This dynamic interaction causes the edge of the carbon lining to chip. This allows the carbon to wedge up under the washer, resulting in washer failure and loose carbon lining segments. High-frequency pulse tests were conducted on the brakes at the vendor after ground tests were run on OV-099 to better understand the instability problem. The OV-099 ground tests were able to induce some lightly damped resonance at plus/minus 300 psi but this response could not be repeated at the vendor because of difference between the laboratory test setup and the flight vehicle. Instrumentation is being evaluated for use in flight on a future flight vehicle. CONCLUSION: Retainer washer failures have occurred on the right main gear brakes for the past 3 flights, including the last 2 OV-099 flights. Evidence suggests that brake/hydraulic dynamic interaction may cause carbon liner edge chipping and subsequent retainer washer failures. The damage is not a safety issue. Hard braking was demonstrated on STS-6 (OV-099) as a development test objective. CORRECTIVE ACTION: No corrective action is required for STS-11. Instrumentation is being evaluated for use in flight on a future flight vehicle to better understand the brake/hydraulic dynamic interaction. EFFECTS ON SUBSEQUENT MISSIONS: None [the following summary was in the computer database but does not match the summary on the original

problem report as given above. see STS-41B-V-29] [DISCUSSION: Postflight inspection after STS-41B found 3 retainer washers broken or missing, carbon edges chipped on 23 brake lining segments and 18 drive clips peened or bent on the right outboard brakes. Carbon liner edge chipping and retainer washer failures have occurred on the right main gear brakes for the last 4 flight. Brake/hydraulic dynamic interaction causes the carbon liner edges to chip allowing the carbon to wedge up under and fail the retainer washers. This dynamic interaction also causes the peening of the drive clips. Ground tests have been unable to to induce a similar dynamic response. Instrumentation will be added to OV-099, starting the flight after STS-41C, to better understand the brake/hydraulic dynamic interaction. An industry wide committee met at JSC in January, 1984, and reviewed the total brake design. They concluded that the Orbiter problems being experienced were not unusual and no safety issues existed. CONCLUSION: Brake/hydraulic dynamic interaction caused carbon liner edge chipping and subsequent retainer washer failures. Retainer washer failures have occurred on the right main gear brakes for the past 4 flight. This damage is not a safety issue. Hard braking was demonstrated on STS-6 (OV-099) as a DTO (development test objective). CORRECTIVE_ACTION: A comprehensive program plan for brake system improvement has been developed and is in evaluation. A detailed math model is being developed and carbon material characterization tests are in progress. Instrumentation will be added to OV-099 starting with flight after STS-41C to better understand the brake/hydraulic dynamic interaction. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE]

Tracking No	Time	Classification		Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-9-V-28		OMS
	GMT: 332:16:10		**SPR**	**UA**		**Manager:**
			IPR	**PR**		
						Engineer:

Title: Right OMS GN2 Regulator Shifted Down During Burns. (ORB)

Summary: DISCUSSION: During the OMS burns the right OMS GN2 regulator lockup pressure was observed to be 8 to 10 psi lower than the lockup pressure during prelaunch. In comparing the right and left OMS GN2 regulator performance, the left OMS GN2 regulator did not exhibit a significant downward shift during any of the burns. The OMS GN2 regulator specification establishes a maximum lockup pressure of 360 psia with a pressure of 325 plus/minus 10 psia for flow conditions. During OMS engine purges subsequent to engine burns, the right OMS GN2 regulator pressure was also 9 to 16 psi below the flow condition specification of 325 plus/minus 10 psia.

The probable cause of the lower pressure is contamination that has restricted the regulator flow. Subsequent regulator usage during OMS-2 and the deorbit burn indicate a trend toward clearing of the contaminant as verified by the improved regulator performance during the deorbit burn engine purge. In a worst case condition restricted GN2 regulator flow can be procedurally accomodated by: 1. Restrict OMS engine restarts a minimum of 10 minutes between starts for zero engine purge flow capability. This time interval allows the trapped propellant in the engine injector to evaporate. 2. Position OMS engine switch to arm after the engine purge sequence to maintain GN2 isolation valve in the open position. This will allow a low flowing regulator to catch up and repressurize the line and accumulator between the regulator and engine control valve. Also, a blow down capability exists using the OMS system GN2 accumulator which provides for a one-start capability. Additional redundancy exists through the capability to perform deorbit burns with either a single OMS engine or the RCS. CONCLUSION: The most probable cause of the downward shift in the right OMS GN2

regulator lockup pressure is contamiantion. The downward regulator shift did not effect the performance of the engine. Low flowing GN2 regulators can procedurally be accommodated without mission impact. CORRECTIVE_ACTION: None for STS-11. Perform leak and functional test on the right OMS GN2 regulator for OV-102 prior to the next scheduled mission (STS-17). EFFECTS_ON_SUBSEQUENT_MISSIONS: None for STS-11. Test required for STS-17 (next OV-102 flight).

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-9-V-29	GN&C
	GMT: 342:23:47		**SPR** 09F018	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: ATVC-3 Flight Control System Channel 3 Failed. (ORB)

Summary: DISCUSSION: Before entry, GPC (general purpose computer)-1 and -2 failed. GPC-2 was reinitialized, but GPC-1 had a hard failure and was powered down. At nose gear touchdown (342:23:47:38 G.m.t.) GPC-2 failed the second time, and the crew placed the FCS (flight control system) channel 3 switch in "override" which is the normal procedure for the loss of a second GPC. An FCS channel 3 failure indication was observed and the main-engine actuator-driver current outputs from ATVC (ascent thrust vector control)-3 indicated zero.

Troubleshooting at KSC isolated the problem to ATVC-3 which was removed and returned to the vendor. The failure was isolated to an overvoltage protection circuit in the ATVC-3 internal power supply. Further analysis also revealed that a brief logic power loss of 5 to 8 milliseconds duration to the ATVC-3 (caused by the break-before-make characteristic of the FCS switches) can inhibit the power output of the ATVC, if the aforementioned circuit fails. The logic power interrupt time depends on how rapidly the switch is actuated. Had the flight procedure required the FCS channel switch to remain in "auto", then the ATVC-3 output power to the actuators would have been maintained and the anomalous condition would not have surfaced. The same condition could have existed within the ASA's (aerosurface amplifiers) which have the same type of overvoltage protection circuits as those contained in the ATVC's. Further analysis determined that the failure of the overvoltage protection circuit in the ATVC-3 power supply was caused by a missing jumper wire on the overvoltage protection printed circuit board. An older design tied the transistor emitter to ground with a jumper wire that was connected to a pad on the circuit board. A new design, used on the overvoltage protection circuits of all the ASA's and in most of the ATVC's on OV-099 and on all subsequent vehicles, connects the emitter to ground by a metal trace (a solid copper path) on the printed circuit board. There has been no problem with the new circuit design. The old design that failed on ATVC-3 was not built per print. The transistor circuits for overvoltage protection are redundant parallel path circuits. The method for testing at the subsytem replacement unit level does not distinguish between parallel paths and the problem cannot be detected at the LRU level. Testing at the vehicle is, and will continue to be, inconclusive, but the FC channel switch will be cycled 10 times from "auto" to "override" to "auto" for a total of 20 logic power interrupts. Only ATVC-4 (serial number 014), slot 4 in OV-099, has the old printed circuit board design. If ATVC-4 fails due to an FCS switch interrupt, the ATVC power switch can be cycled and the power output of the ATVC-4 can be restored. [The ATVC's will also be exercised with the ASA's during the OPS-8 tests prior to entry on each flight starting with STS-11.][not included in original problem report] CONCLUSION: A failed overvoltage protection circuit in the ATVC-3 power supply and an FCS switch interruption (power loss) of 5 to 8 milliseconds duration in the ATVC-3 logic power caused the ATVC-3 FCS channel 3 failure. Failure of the overvoltage

protection circuitry was caused by a missing jumper wire on the overvoltage protection printed circuit board. CORRECTIVE_ACTION: Failure analysis will continue on the cause for the missing jumper wire for grounding of the transistor emitter on the ATVC-3 overvoltage protection printed circuit board. The results of this action will be tracked via CAR 09F018. A special test will be conducted at KSC to exercise the overvoltage protection circuit in the ASA's and ATVC's on OV-099 prior to STS-11. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-9-V-30	HYD
	GMT: 342:23:32		SPR	UA	Manager:
			IPR	PR	
					Engineer:

Title: Water Spray Boiler 1 Bypass Valve Indication Malfunction. (ORB)

Summary: DISCUSSION: At 342:23:25:20 G.m.t., the hydraulic system 1 bypass valve moved to the water spray boiler 1 heat exchanger position, but the valve position indication (V58X0181E) did not indicate the change. The change of state of the hydraulic bypass valve was verified by water spray boiler spray cooling which controlled the hydraulic fluid inlet temperature to a maximum of 228 deg F at 342:23:28:20 G.m.t. This temperature is about 8 deg F higher than had been observed on previous OV-102 flights. The control outlet temperature for water spray boiler hydraulic fluid heat exchanger flow is 210 deg F and was nominal on this mission.

Postflight tests of water spray boiler 1 could not duplicate the bypass valve indication malfunction. Since redundancy exists in the three hydraulic systems, no further action is required. CONCLUSION: The cause of the water spray boiler 1 bypass valve indication malfunction is unknown. CORRECTIVE_ACTION: None for STS-11. The OV-102 water spray boiler 1 bypass valve operation and associated valve position indication will be monitored on future flights for recurrence of the malfunction. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-9-V-31	STR
	GMT:		SPR 09F025	UA	Manager:
			IPR	PR	
					Engineer:

Title: Waste Management System Door Opened During Entry. (ORB)

Summary: DISCUSSION: The crew reported the WMS (waste management system) door came open during entry. The door opening followed a period of vehicle vibration and deceleration. The door had been latched and checked in accordance with established procedures prior to entry.

The door latch had been modified to have at least 0.2 in. of bolt engaged in the striker plate. A blocking plate has been designed to be added to OV-099 for 41-B (STS-11) to block the bolt in place. The plate will prevent the bolt from backing out. This modification will establish whether the door comes open due to vibration backing the bolt out against the spring pressure, or whether the door frame deflects sufficiently to disengage the striker plate. Results from flight 41-B (STS-11) will be used to determine if further action is required. CONCLUSION: The WMS door latching technique was inadequate for keeping the door closed during entry. CORRECTIVE_ACTION: For 41-B (STS-11), a blocking plate will be added to the door latch to prevent the bolt from backing out. Evaluation of flight results and any further corrective action, if required, will be tracked on CAR 09F025. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification		Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-9-V-32		TPS
	GMT:		SPR	UA		Manager:
			IPR	PR		
						Engineer:

Title: Left-Hand OMS Pod TPS Damage (ORB)

Summary: DISCUSSION: postflight inspection of the left-hand OMS (orbital maneuvering system) pod showed damage to several TPS (thermal protection system) tiles. Further inspection revealed some damage had occured to the honeycomb structure at a point where the lower inboard side of one tile was missing. This tile is located in the first row of while tile above the cargo bay mold line. The tile fracture was such that the tile material was missing in a small area down to the tile bond line. The burn damage beneath this tile extended through the outer sheet, the honeycomb, and the inner face sheet in a small area behind the tile.

The same corresponding tile on the right-hand OMS pod was also damaged, but not to a sufficient depth to expose the tile bond line area. Inflight photographs of the OMS pods show that the damage was present on-orbit, indicating that it most likely was caused by debris during ascent. Entry heating from the 57 deg inclination orbit along with the heaviest vehicle yet flown, resulted in higher OMS pod temperatures than previously experienced. CONCLUSION: The OMS pod damage experienced on this flight was the result of the high entry heating profile coupled with the specific damage that occured to the OMS pod tile. Lower heating profiles on STS-11 minimize the risk of recurrence. CORRECTIVE ACTION: The OMS pod will be removed from OV-102 and repaired. As a result of this damage, and damage to the OMS pod TPS from previous flights, several TPS design improvements are currently under evaluation for incorporation on future flights. EFFECTS ON SUBSEQUENT MISSIONS: None [the following summary was in the computer database but does not match the summary on the original problem report as given above -> see STS-41B-V-27] [DISCUSSION: The left-hand OMS pod sustained severe tile and graphite epoxy structure damage during STS-41B. The damage source owas ice which had formed around the potable and waste water dump nozzles which are lcoated on the left-hand mid fuselage sidewall approximately 110 inches aft and 30 inches below the center of the side hatch. The ice detached from the Orbiter and impacted the pod at approximately 1330 seconds after the start of entry, which is the time of maximum heating on the OMS pod. The velocity was approximately Mach 4.5 and the angle of attack was approximately 22.5 degreed. The inner face sheet of the graphite epoxy honeycomb structure on the front of the left OMS pod was delaminated over a large area and requires replacement of the structure for the outboard nose panel. Other damage areas included glancing debris "hits" on the left-hand chine which caused shallow damage. One tile at the forward outboard corner and one tile at the aft outboard corner of the

left-hand nose landing gear door had a chipped corner. Further, the forward tile was slightly slumped. CONCLUSION: The left-hand OMS pod was damaged during entry by ice caused by on-orbit water dumps. The debris hits were probably caused by debris from the external tank. The forward tile slumping was caused by an out-of-tolerance gap. CORRECTIVE_ACTION: For mission 41-C the OV-103 left-hand pod is installed on OV-099. This pod incorporates thick TPS tiles on the forward section. Test data indicates the thicker tile is approximately 6 times more resistant to impact damage than the tile which was folwon on STS-41B. The right-hand pod TPS is the same on the previous mission. For subsequent missions, the OV-099 and OV-102 OMS pods will incorporate, as a minimum, the OV-103 thick tiles on the forward section. For the debris damage and the slumped tiles, standard tile repair and replacement methods have been accomplished.
EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE]

Tracking No	Time	Classification		Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-9-V-33		C&T
	GMT: 335:19:15		**SPR**	**UA**		**Manager:**
			IPR	**PR**		
						Engineer:

Title: Invalid Uplink Commands From The Mission Control Center To The Spacelab. (ORB)

Summary: DISCUSSION: During STS-9 at 335:19:15 G.m.t. and again at 338:17:03 G.m.t., the SCOS (Subsystem Computer Operating System) software generated error messages when the HDRR (High Data Rate Recorder) "standby" command was uplinked from the MCC (Mission Control Center) to the Spacelab. This was an MCC-stored command and was uplinked over a thousand times during the mission.

The HDRR "standby" command is a payload-unique through-put command (TPC) which has no Orbiter validation, except for standard MDM hardware checks, prior to transmission to the Spacelab SCOS. The through-put type of command was implemented so that a large number of commands could be routed to the payloads in a short period of time. A low signal-to-noise ratio on the command link will result in a greater number of command rejections (command word fails error check (BCH) code). The low signal-to-noise ratio can occur because of poor antenna-look angles. On STS-9, the uplink was via S-Band due to TDRSS (Tracking and Data Relay Satellite System) failures. Postflight data relative to the SCOS rejection of the HDRR "standby" commands indicated noisy uplink/downlink data at the times when the commands were rejected. Two tandem Spacelab TPC's were merged in the SM (system maintenance) GPC (General Purpose Computer) two-stage buffer resulting in an erroneous command being sent to the SCOS and this caused the first reject. Data review has no determined the command-word bit configuration involved in the second SCOS invalid command rejection; however, there were low AGC (Automatic Gain Control) levels at the time. An Orbiter software code audit indicated that the Orbiter software meets the requirements in the Spacelab Level A ICD (Interface Control Document). Furthur analysis indicates that uplink processing of PL (payload) TPC's, in which the last command word is in error, will result in the command not being passed to the applicating process. Any subsequent PL TPC issued before the two-stage buffer is cleared will have the first word rejected (first/last word error) and the intermediate command words, as well as the last command word will be placed into the two-stage buffer following the first uplink load's data. This concatenated command will be sent to the application and, thence, to the appropriate payload. A user's note has been prepared to alert future payload users of the potential for command errors. The problem is related only to the effective single-stage use of the uplink two-stage buffer by the payload

TPC's. All Orbiter critical and hazardous commands are two-staged commands (i.e., ground-verified prior to execution). For STS-11, the SPAS is the only payload that receives commands through the Payload Signal Processor. There are only four commands and these are all ground verified prior to execution. CONCLUSION: The invalid commands were caused by low signal-to-noise ratio in the uplink transmission and the subsequent payload-unique two-stage processing of TPC's. The problem can not occur on STS-11 since all commands to the payload are grounf verified prior to execution. [TPC's used to load the Solar Max computer during STS-41C will be verified by ground interrogation of a Solar Max memory dump prior to finalizing the Solar Max computer load.] [not included in original problem report] CORRECTIVE_ACTION: A users note has been generated to document the two-stage processing of TPC's to alert future payload users of potential command errors. [Future payloads that use payload through-put commands have been reviewed. There is no concern for the next user, STS-41G, since the ERBS (Earth Resource Budge Satellite) has excellent error detection capability. An interim fix, however, for the second user, STS-51B (Spacelab 3), is in work with a long-term fix proposed by STS-51F (Spacelab 2).] [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification		Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-9-V-34		GN&C
	GMT: 342:23:47		**SPR**	**UA**		**Manager:**
			IPR	**PR**		
						Engineer:

Title: Inadvertent Flight Control Channel 2 Shutdown. (ORB)

Summary: DISCUSSION: Prior to entry, GPC's (General Purpose Computers) 1 and 2 failed. GPC-2 was reinitialized, but GPC-1 had a hard failure and was powered down. FC channel 4 was powered down for entry to preclude 2 strings being on a failed GPC, should GPC-4 fail. The remaining GPC's were restrung to drive the four FC (Flight Control) hardware strings as follows:

GPC 2 3 4 FC channel 1 3 2 and 4 When GPC-2 failed again shortly after nosewheel touchdown at 342:23:47:38 G.m.t., FC channel 1 was immediately comfaulted freezing the last command to ASA (aero surface actuator) 1 and replacing FC channel 1 with 4 in redundancy management (RM) mid-value select for the elevons, rudder and speed brakes. Then channel 1 went to bypass. The crew went to "override" on channels 1 and 3 (instead of channels 2 and 3) and turned off FC channel 2 (instead of FC channel 1). The failed GPC-2 could not process the override. Channel 1 remained comfaulted and went back to bypass. This resulted in the aerosurfaces being driven by only FC channel 3. Control of the aerosurfaces was not lost, but RM (redundancy management) of aerosurface positions for internal use became erroneous. The RM was performing mid-valve select on the outputs of FC channels 2, 3, and 4. Since channel 2 and 4 had been turned off, their outputs were zero and channel 3 appeared high. Thus the RM indicated that the aerosurfaces were frozen at electrical zero. This information is used to drive the elevator trim function in flight and could have provided as much as a 12-degree elevator trim step. The trim function is discontinued at nosewheel touchdown. Since the inadvertent switch activation occurred after nosewheel touchdown, no negative results occurred. CONCLUSION: The inadvertent flight control channel 2 shutdown after nosewheel touchdown would have resulted in a marginal flight control system configuration if the shutdown had occurred in flight. CORRECTIVE_ACTION: The crew will mark the GPC/string configuration below the FC channel switches should restringing be required on future missions. The center-

seat crewman will track GPC string assignments.Flight procedures involving restringing of the computers and the use of the FC channel override switches will be reviewed to insure safe operations should multiple or stacked failures occur on future missions. Also uunder evaluation are control and display panel enhancements to reduce the potential for inadvertant flight control switch activations. [To insure safe operations should future multiple or stacked GPC failures occur, a cue card overlaid with a markable tape has been developed and is available for crew use. The cue card will be marked with the new GPC/FC channel assignments and will serve as a stringing identification to be placed under the FC channel switches on panel C3.] [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE